

PALYNOMORPHS AND CALCAREOUS NANNOPLANKTON BIOSTRATIGRAPHICAL STUDY ON UPPER JURASSIC- LOWER CRETACEOUS OF BED 8-1 WELL, WESTERN DESERT, EGYPT

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This paper deals with a palynostratigraphic and calcareous nannoplankton biostratigraphical study on the Upper Jurassic / Lower Cretaceous rock units of the Bed 8-1 well drilled, in the northern part of the Western Desert, Egypt. Seven rock units were recognized and discussed. More than 88 of palynomorphs species and 36 calcareous nannoplankton species were identified. Based upon this rich representation of the taxa, five palynomorphs zones and four calcareous nannoplankton zones were detected. A correlation between these zones and those recorded from Africa and other locations is given. Also, the Upper Jurassic / Lower Cretaceous boundary is discussed.

Key Words:

Palynology, Palynomorphs, Spores, Pollen, Assemblages, Angiosperm gymnosperm, Dinoflagellate and cretaceous.

INTRODUCTION

The Upper Jurassic - Lower Cretaceous succession of the study well comprises seven rock units. These rock units from base to top are Khatatba, Masajid, Shaltut, Alamein, Kharita, Bahariya and Abu Roash "G", formations.

This work is based on the study of calcareous nannoplankton and palynomorphs assemblages obtained from 21 cutting samples from the Bed 8-1 well (Fig. 1).

Many biostratigraphic studies in Egypt, on the Late Jurassic - Early Cretaceous rock units has been subjected by several authors for long time among of these works are, [1-31].

LITHOLOGY

The Upper Jurassic - Lower Cretaceous succession of the study well comprises seven formations fig. (2). The lithologic rock units were taken from

composite well log (Bed 8-1: Lat., 29°, 58', 52.74" N and Long., 27°, 49', 31.9" E). The summary descriptions of these formations units, was given, from base to top, as follows:

Khatatba Formation: 119 m in thickness and mainly composed of shale: blocky to sub blocky, yellowish brown, medium hard to soft intercalated with sandstone, medium hard and some limestone, slightly argillaceous.

Masajid Formation: 115.5 m in thickness and composed of limestone, argillaceous, jackstone to mudstone, medium hard, streaks of shale, blocky, medium hard and sandstone, fine, medium hard, at the base.

Shaltut Formation: 661 m in thickness and composed of Sandstone: medium hard with streaks of shale medium hard and streaks of siltstone, moderately brown, hard.

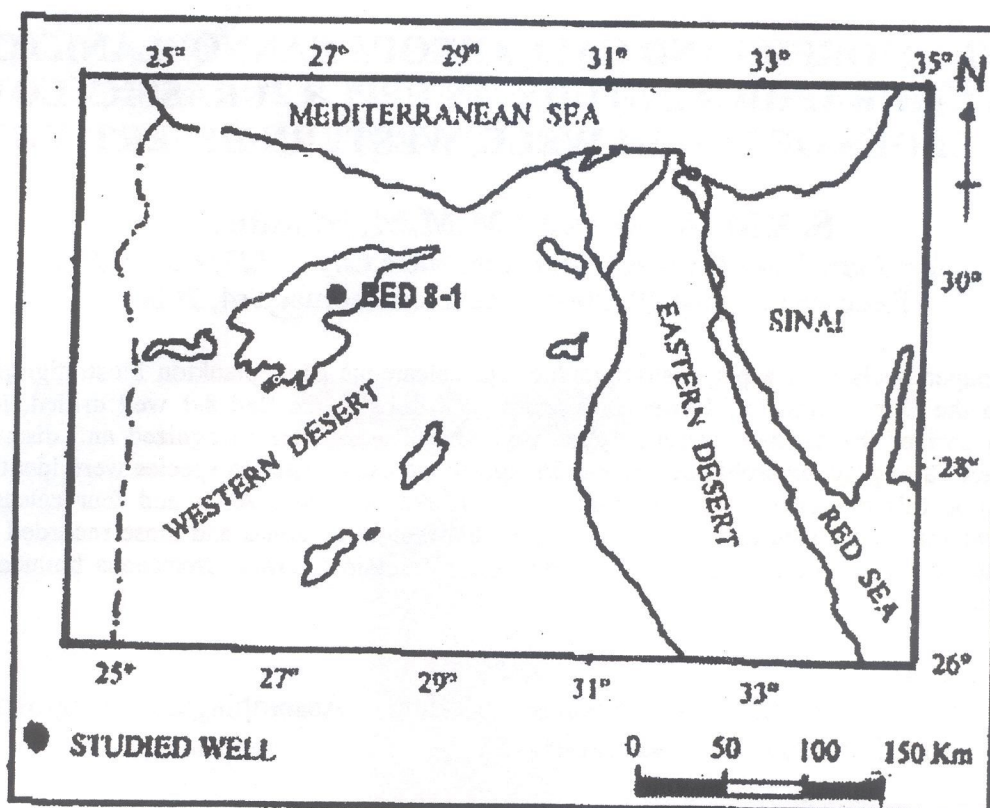


Fig 1: Location map

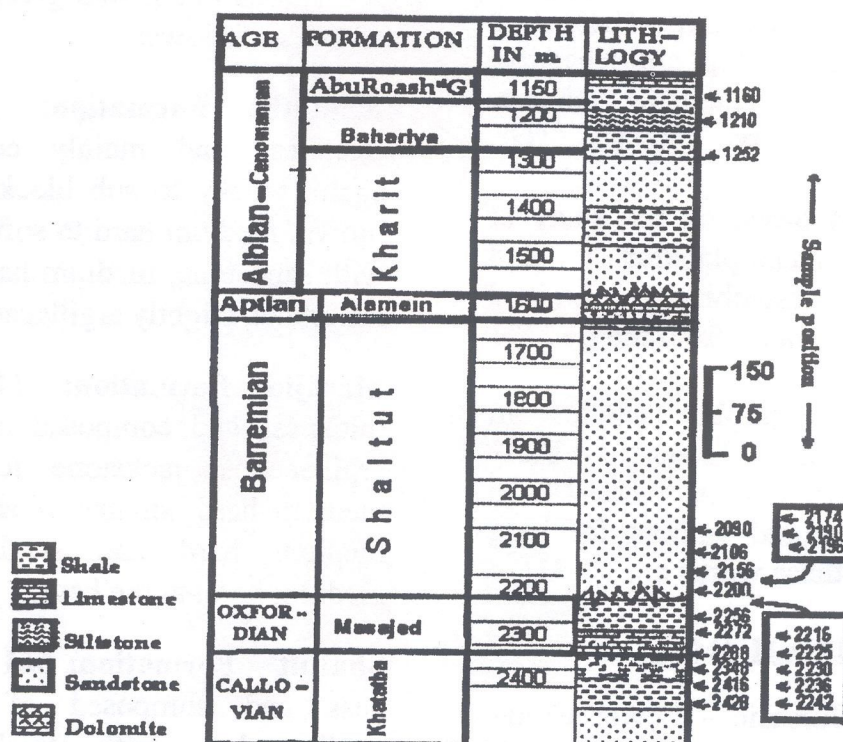


Fig. 2: Lithologic log of the studied rock units of BED 8-1 well, Western Desert, Egypt

Alamein Formation: 18 m in thickness and composed of Dolomite, microcrystalline, hard some streaks of very fine sands and Limestone at the base.

Kharita Formation: 280 m in thickness and composed of sandstone: fine, medium hard, with streaks of shale, blocky to sub blocky, medium hard siltstone, moderately brown, hard.

Bahariya Formation: 97 m in thickness and composed of sandstone: very fine rounded to surrounded, medium hard, with streaks of shale, medium hard to soft and streaks of siltstone, medium hard to hard.

AbuRoash "G" Member : 72.5 m in thickness and mainly composed of shale: blocky to sub blocky, yellowish brown, medium hard to soft, with streaks of sandstone, medium hard and limestone, slightly argillaceous, wackestone to mudstone, medium hard to soft.

Methods and techniques:

a- Palynology: Dilute hydrochloric acid (HCL 10%) was added to the cutting samples to remove any carbonates, after 3 hours the residue washed 3 times with distilled water, then the hydrofluoric acid (HF 49%) was adding. After 12 hours, the residue was washed several times. Dilute (HCL 10%) was added fore a few minuets and washed 3 times with distilled water. A heavy liquid about of 1.8 specific gravity was prepared to separate the light palynological residue, which was then sieved through a 15- μ nylon sieve. Two slides or sometimes more investigated depending on the enrichments of the sample.

Dinoflagellate cysts, spores and pollen grains were studied and iden-

tified by using a transmitted light Binocular Microscope with 10X20 U to 10X40 U. magnifications.

b- Nannoplankton: Methods of study calcareous nannoplankton and the preparation techniques have been presented by many authors such as [32-35]. The procedure is briefly outlined as the follows:

- 1- The disaggregated fine materials were soaked in distilled water with some agitation
- 2- Let it to settle for a few seconds to eliminate most particles above 30 - 40 microns and to obtain high concentration of nannofossils.
- 3- A few drops of the suspension were sucked from the upper part with a medicine dropper.
- 4- The content of the medicine dropper was spread over a glass cover and dried on a hot electric plate.
- 5- Put a drop of Canada balsam on the cover.
- 6- Cooked the slide on a hot plate for approximately a half minute to make the slide more durable and easier to store.

An Olympus polarized microscope with X100 oil emersion lens is used for the identification of the calcareous nannofossils. All samples after preparation and materials are deposited in the laboratories of the Exploration Department, EPRI, Cairo, Egypt.

BIOSTRATIGRAPHY

The intensive study of the vertical distribution of the separated fauna and flora contents (figs. 3-5) led to subdivide the studied rock units into five palynomorph biozones and four calcareous nannoplankton biozones. Correlation, between the recognized zones based on palynomorphs zones with those calcareous nannofossils, are given (fig.6).

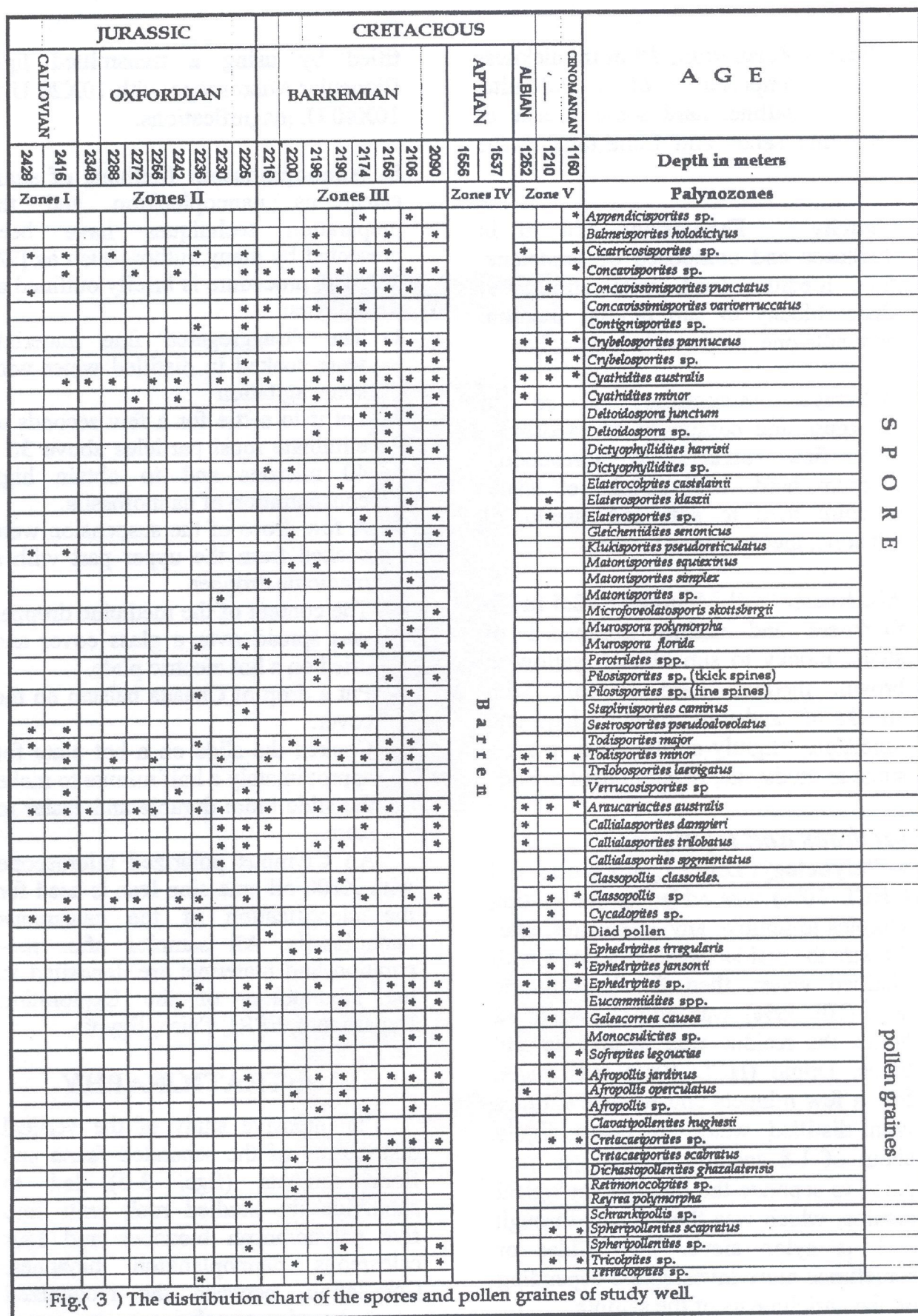


Fig. (3) The distribution chart of the spores and pollen grains of study well.

Fig. 3: The distribution chart of the spores and pollen grains of study well



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Concavisporites jurienensis, *Concavissimisporites verrucosus*, *Cyathidites* spp., *Klukisporites pseudoreticulatus*, *Todisporites major*, *Todisporites minor*, *Sestrosporites pseudoalveolatus* and *Verrucosisporites* sp. On the other hand pollen grains are rare and represented by *Cycadopites* sp., *Araucariacites australis*, *Callialasporites trilobatus* and *Callialasporites* sp. while dinoflagellate cysts are rich and show high diversity of the following species: *Cribroperidinium*

sp., *Lithodonia jurassica*, *Dichadogonyaulax chondra*, *Pareodinia ceratophora*, *Adnatosphaeina* sp., *Korystocysta gochti*, *Korystocysta* sp., *Sentusidinium villersense*, *Hystri-chosphaerina orbifera*, *Stiphrosphaeridium* sp., *Ctenidodinium panneum*, *Ctenidodinium chondrum*, *Ctenidodinium* sp., *Meiourogonyaulax* sp., *Gonyaulacysta jurassica*, *Sentusidinium* sp., *Systematophora* sp. *Cribroperidinium* spp., and *Klukisporites pseudoreticulatus*.

Callovian - Oxfordian		Hautervian-Barremian										Aptian				Albien-Casementan	Age	
Johanna	Masjed	Shaitut										Alamein-Delemba	Bahariya Kharita	Formation				
Baron	Conusphaera masjedensis	Nannoconus colomii										Nannoconus bucheri	Not studied	Edellithus turkestanensis	Calcareous nannoplankton Zone			
2426	2416	2396	2386	2372	2356	2342	2326	2310	2294	2278	2262	2246	2230	2214	1222	1180	Sample depth in m	
	R	R	R	R													Cyclagelosphaera deflandrei	
	R	R	R	R													Conusphaera mediana	
	R	R	R	R													Ellipsagelosphaera britannica	
																	Nannoconus colomii	
																	Parahololithus asper	
																	Nannoconus abundans	
																	Pseudolithophidites quatuorbacili	
																	Nannoconus carniolensis	
																	Nannoconus globulus	
																	Nannoconus steinmanni	
																	Nannoconus circularis	
																	Nannoconus rainubus	
																	Lithraphidites bollii	
																	Nannoconus bucheri	
																	Lithraphidites c.carniol	
																	Braarudosphaera regularis	
																	Vagalapilla metalosa	
																	Braarudosphaera africana	
																	Microhabdulus decoratus	
																	Nannoconus elongatus	
																	Zygodiscus diplogrammus.	
																	Nannoconus truitti frequens	
																	Parahololithus angustus	
																	Staurhabdus quadriculatus	
																	Cretarhabdus conicus	
																	Rhagodiscus angustus	
																	Nannoconus truitti	
																	Nannoconus frequens	
																	Lithraphidites carniolensis	
																	Nannoconus regularis	
																	Aspidolithus parvus	
																	Rucinolithus irregularis	
																	Watznaueria britannica	
																	Ellisellithus turkestanensis	
																	Watznaueria barnesae	

Fig. 5: The distribution chart of the calcareous nannoplankton of study well

Ctenidodinium panneum has a known range from Kimmeridgian to Early Portlandian from England and Denmark [32] and Bathonian to Tithonian of northeast Libya [37]. Meanwhile [38] reported its presence in the Upper Kimmeridgian to Lower Berriasian of northeast Libya. This species was recorded from north Western Desert from Kimmeridgian to Tithonian sediment [39] and from Kimmeridgian [40]. [41] recorded it from Bajocian to Bathonian from Eastern Desert.

Korystocysta gochtii: [42] mentioned that *Korystocysta gochtii* is characterizing for Callovian.

In Egypt *Klukisporites pseudoreticulatus* was recorded from the Upper Jurassic of Kharga Oasis [43] Kimmeridgian to Purbeckian of Kharga Oasis [44] (; Bathonian to Callovian of Sinai [45]; Oxfordian of north Western Desert [46] and Early Oxfordian of north Sinai [47]. The same species was recorded from Jurassic to Lower Cretaceous rocks of British and southern England [48,49], from the Upper Jurassic of Western Canada [50] and from Maryland [51].

Lithodonia jurassica was reported the stratigraphic importance of *Lithodonia jurassica* in the Callovian sediments of Black – Bahama Basin [47]. In the southern Germany [52].

From the above discussion this assemblage zone can be assigned as Callovian age.

II- *Gonyaulacysta jurassica* and *Hystrichosphaerina orbifera* Assemblage Zone: (Oxfordian):

The study of the Msajid Formation represented mostly domination of the small spores, e.g. *Cyathidites minor* and a rare of *Cicatricosisporites* sp.,

Verrucosisporites sp., *Cyathidites* spp., *Concavisporites jurienensis*, *Concavisporites* spp. and *Concavissimisporites verrucosus*. Pollen grains are also rare and mostly species detected; *Classopollis* sp., *Spheripollenites* sp., *Cycadopites* sp., *Araucariacites australis*, *Callialasporites trilobatus* and *Callialasporites* sp. At the same time the Dinoflagellates cysts are rich and represented by *Systematophora penicillata*, *Cribroperidinium* sp., *Pareodinia ceratophora*, *Pareodinia* sp., *Sentusidinium* sp. *Systematophora areolata*, *Systematophora* sp., *Millioudinium globatum*, *Cribroperidinium* spp., *Ctenidodinium*.

Hystrichosphaerina orbifera is recorded from the Callovian and early - middle Oxfordian of Britain and Northern France [55-57]. The first occurrence of *Hystrichosphaerina orbifera* has recorded of the Middle Oxfordian from southern Germany [56, 57]. The same age was recorded from Egypt [54].

Gonyaulacysta jurassica was recovered of the Bathonian age in the North Western Desert, Egypt [58,59] and from Kimmeridgian age [60]. In north Sinai, it is reported from the Callovian age [47]. In the Eastern Desert, Egypt [41] recorded it from Bathonian - Callovian. This species is widely distributed in North America, Europe and Africa. It is recorded from late Bathonian to Tithonian of the northeast Libya [37] and from Oxfordian [38]. In Europe, it is recorded from Upper Jurassic [56, 42, 36, 61].

The *Gonyaulacysta jurassica* species remains an important cosmopolitan in the Oxfordian as it was recognized as a zonal species in Western Europe and North Africa [62, 42]. This zone could be correlated with [54, 63] Concurrent

Range Zone *Gonyaulacysta jurassica* - *Epiplosphaera reticulospinosa* (of Oxfordian age) from Western desert, Egypt.

Depending on the above discussion of the palynomorph assemblages this zone is concerned as Oxfordian age. In the present work zone II is equivalent to the nannoplankton *Conusphaera mexicana* Zone.

III - *Muderongia simplex* Assemblage Zone: (Barremian)

This biozone is characterized by the relative predominance of *Pseudoceratium anaphrisum*, and regular representation of monocolpate angiosperm pollen grains. The palynomorph assemblage characterizing this palynozone is well represented and the recovered assemblage here includes mainly trilete spores with smooth exine, together with other striate and sculptured forms. The presence of undoubtedly Early Cretaceous spores recorded everywhere in Egypt and other regions by many authors such as: *Muderongia simplex*, *Pilosporites* sp., *Concavissimisporites punctatus*, *Trilobosporites apiverrucatus*, *Appendicisporites tricornitatus*, *Balmeisporites holodyctius*, and an important palynological event herein is the persisting occurrence of *Murospora florida*. Gymnosperm pollen grains are frequent and represented by a marked percentage of *Araucariacites australis*, *Classopollis* sp., *Callialasporites dampieri*, *Diad pollen* and *Spheripollenites psilatus*. Another marked palynological event herein is the first occurrence of *Ephedroides pollen*. Angiosperm pollen grains are few and represented by *Stellatopollis barghoornii*, *Clavatipollenites* sp., and "*Inaperturopollenites*" *crisopolensis*.

Marine dinocysts represent a marked percentage, meanwhile they are rarely occurred and sometimes absent, they include mainly association of *Aptea anaphrisa*, *Subtilisphaera senegaliensis*, *Cribroperidinium orthoceras*, *Cyclonephelium* sp. and *Oligosphaeridium* complex (rare).

[64, 41] approved a corresponding zone (*Muderongia simplex*) from the Western Desert of middle-late Barremian. [54] mentioned that, the most striking elements in the Barremian is the appearance of angiospermous pollen grains such as *Clavatipollenites*, *Asteropollis*, *Liliacidites*, *Retimonocolpites*, *Stellatopollis* cf. *barghoornii* and *Tucanopollis crisopolensis*. Marine dinocysts are represented by "*Pseudoceratium*" *anaphrisum*, *Pseudoceratium retusum*, *Coronifera oceanica*, *Cerbia tabulata*, *Systematophora silyba*, *Cribroperidinium edwardsii* and *Cribroperidinium orthoceras*. [40] have confirmed the above conclusion by mentioning; *Trilobosporites* / *Impardecispora apiverrucata*, *Cicatricosisporites* spp. with angiosperm pollen grains *Clavatipollenites* sp., *Stellatopollis* cf. *barghoornii*, *Liliacidites* / *Brenneripollis reticulatus* and *Afropollis* sp. Associated marine dinocysts include mainly *Cribroperidinium edwardsii*, *Subtilisphaera perlucida*, *Pseudoceratium anaphrisum* and *Muderongia simplex*. [65, 66] concluded that, the strata immediately underlying the first appearance tricolpate and *Afropollis*, in Mersa Matruh well, have been dated as Late Barremian to earliest Aptian. [67, 38] recorded from Libya a similar assemblage of late Hauterivian to middle Barremian age dominated by dinocysts *Cyclonephelium hystrix*, *Muderongia simplex*, *Systematophora* sp. and *Aptea anaphrisa*, in Libya. Also, [38] recorded an assemblage shows the first appearance of *Subtilis-*

phaera senegalensis which is firstly recovered from Late Hauterivian in Libya. [68, 64] recorded angiosperm pollen "*Inaperturopollenites*" *crisopolensis* from the Hauterivian - Barremian sediments, in West Africa and in Egypt. [41] believed that the occurrence of the characteristic taxa of *Subtilisphaera senegalensis* and *Cribroperidenium orthoceras* are considered to be stratigraphically important range from Late Hauterivian - Barremian as used in zonal schemes in northwest Europe and Tethyan region.

Due to the above discussion it can assign the Barremian age to this assemblage zone. In the present work zone III is equivalent to the nannoplankton *Nannocnus colomii* zone.

IV - Barren Zone: (Aptian)

A gap due to unconformity surface or stratigraphic hiatus exists between Albian rock unit and Aptian rock unit causes the absence of Dahab Formation and the lower part of Kharita Formation. Two samples are taken and studied from the Aliment Formation and they are barren from any palynomorphs.

In the present work zone III is equivalent to the nannoplankton *Nannocnus bucheri* zone.

V - *Concavissimisporites punctatus* and *Elaterosporites klaszii* Assemblage (Albian - Cenomanian):

A gap of unstudied interval is due to difficult presentation of samples from Kharita Formation. Three samples were studied one in Kharita Formation and two in Bahariya Formation. The main recorded species from these three samples are: the spores are slightly increasing in the total percentage and occurred by *Cyathidites australis*, *Cyathidites minor*, *Concavissimisporites punctatus*, *Cicatricosisporites*

minutistriatus, *Cicatricosisporites* sp., *Microfoveolatosporis skottsbergii*, *Crybelosporites punnucous*, *Elaterosporites klaszii*, *Elaterosporites* sp., *Galeacornea causea* and *Todisporites* sp. The relative abundance of some important taxa of the pollen is obviously changed, among gymnosperm pollen predominant are *Inaperturopollenites* sp., *Monosulcites* sp. and *Classopollis* sp. . Angiosperm are represented and among of them, *Afropollis jadinus*, *Cretacaeiporites* sp., *Retimonocolpites* sp., *Tricolpites* sp. and *Retitricolpites* sp. The occurrence of dinoflagellate cysts are scarce and represented by *Oligoshaeridium* complex, *Oligoshaeridium* sp., *Coronifera tubulosa*, *Florentinia radiculata*, *Florentinia* sp., *Pseudoceratyum* sp., *Systematophora* sp. and *Pareodina* sp.. There are some foraminiferal linings are present.

The first appearance of *Afropollis jadinus* is taken to demarcate the Albian sediments from the older ones [68, 69, 70]. It is well known from the Albian - middle Cenomanian of Egypt [71, 72, 73, 74, 69, 70, 75, 76, 77, 78, 79].

Crybelosporites pannucous is well known spore from the Albian-Cenomanian of Egypt, by [71, 72, 80, 75, 81, 78]. It was also reported from the Albian and Albian-Cenomanian of Maryland [51]; Tunisia [82]; Peru [83]; South Oklahoma [84, 85]; Brazil [86]; offshore east USA [87]; northeast Libya [88]; west Canada [89]; Colombia [90] and Sudan [91, 92].

Concavissimisporites punctatus recorded as Albian-Cenomanian of the Western Desert [93], Lower Cretaceous of Egypt [64, 41], Barremian-Albian of Maryland USA [63], Jurassic-Cretaceous of Libya [38].

Elaterosporites klaszii is another important Albian-Cenomanian index

form in Egypt [71,72, 94, 95, 96, 70, 74, 97, 80, 76, 77, 78]. It was also recorded from the Albian-Cenomanian of Northern Gondwana, from West Africa and South America [98, 99, 100, 101, 102, 103, 104, 105, 90]; south Switzerland and Italy [106]; northeast Libya and the Sudan [88, 37, 67, 91, 74, 107].

Galeacornea causea indicate Middle Cretaceous [93]; and Cenomanian of Egypt, [64], Albian-Cenomanian of West Africa [98, 100]; Peru [101] and Brazil [86, 102]. From the above discussion, Zone V most likely represented Albian – Cenomanian age.

In the present study, zone V is equivalent to the nannoplankton *Eifellithus turrisseifeli* zone.

B- Calcareous Nannoplankton Study:

The study of calcareous nannoplankton content of Masajid, Shaltut, Alamein, Kharita, Bahariya and Abu Roash formations led to identify of 36 species belonging to 18 genera. Its distribution is given in figure (5).

According to the stratigraphic range and the first and the last appearance of the identified calcareous nannoplankton species led to recognizing four nannoplankton zones. The late Jurassic zonation is followed [108, 109] and while the Early Cretaceous Early Cretaceous is followed [110].

Four nannoplankton zones are recognized and discussed herein, from base to top, as follows:

1- *Conusphaera mexicana* Zone:

The *Conusphaera mexicana* zone includes the interval from the FO of *Conusphaera mexicana* to the FO of *Lithraphidites carniolensis*. According

to [35, 111]. The *Conusphaera mexicana*, appears at the base of the Tithonian. In the present study the *Conusphaera mexicana* Zone include the interval from the FO of *C. mexicana* to FO of *Nannoconus colimi*. It is recorded from the top of Masajid Formation with thickness 172 m. This zone is very rare and very poor in calcareous nannoplankton except three species only *Conusphaera mexicana*, *E. britannica* and *Cyclagelosphaera deflandei*. The identified fauna of this zone is of Late Jurassic age and according to the present study this zone is equivalent to the assemblage Zone II (Oxfordian) of palynomorph biozones Fig (6).

2- *Nannoconus colimi* Zone:

The base of this zone is marked by the first appearance of *Nannoconus colimi* [112]. In the present study the *Nannoconus colimi* Zone comprise the interval from FO of *N. colimi* to the FO of *Nannoconus steinmanni* and *Nannoconus globules*. It is recorded from Shaltut Formation with thickness 152 m.

The *Nannoconus colimi* Zone is characterized by a rare association of calcareous nannoplankton which include *Nannoconus minutus*, *N. steinmanni*, *N. globules*, *N. circularis*, *N. colimi*, *N. bucheri*, *N. abundans*, *Lithraphidites*, *Conusphaera carnial*, *Pseudolithraphidites quattuorbacill*, *Braarudosphaera regularis* and *Parhabdolithus asper*.

It is assigned to Early Cretaceous (Hauterivian-Barremian) age and according to the present study this zone is equivalent to the assemblage zone III (Barremian) of palynomorph biozones Fig (6)

Cretaceous				AGE			
Jurassic	Callovian	Oxfordian	Barremian	Aptian	Albian-Cenomanian		
	Khatatba	Masajed	Shaltut	Alam. Dolo.	Bahariya - Kharita		
	I - Otenidodinium panneum and Korystocysta gochtili	II - Gonyaulacysta jurassica and Hystrichosphaerina orbifera			V- Concavississporites punctatus - Elaterosporites Kiaszii		
	IV - Barren					Palynological Zones	
Uncoformity surface							
Jurassic	Barren	Conusphaera mexicana	Nannoconus colomii	Nannoconus bucheri	Not studied	Eiffellithus tuniseiffelii	Nannofossils Zones
	Khatatba	Masajed	Shaltut	Hauterivian-Barremian	Alam. Dolo.	Bahariya - Kharita	FORMATION
	Callovian - Oxfordian		Aptian		Albian-Cenomanian	AGE	
	Cretaceous						

Fig(6): Zonal correlation chart between nannoplankton and palynomorph zones

Fig(6): Zonal correlation chart between nannoplankton and palynomorph zones

Fig. 6: Zonal correlation chart between nannoplankton and palynomorph zones

3- *Nannoconus bucheri* Zone:

The *Nannoconus bucheri* Zone of [110] comprises the interval from the F.O. of *N. bucheri* and the F.O. of *N. elongates* to F.O. of *N. circularis*.

This zone in the present study is defined by the occurrence of F.O. *N. truitti frequens*, *Microhabdulus decoratus*.

The main assemblage recorded from this zone is *N. truitti frequens*, *N. elongates*, *N. carniolensis*, *N. bucheri*, *Zygodiscus diplogrammus*, *Microhabdulus decoratus*, *Braarudosphaera africana*, *Lithraphidites*, *Conusphaera carnial*, *Lithraphidites carniolensis*, *Parhabdolithus asper* and *Vagalapilla matalosa*. It is assigned to the Aptian age and according to the present study this zone is equivalent to the barren zone IV (Aptian) of palynomorph biozone Fig (6).

4- *Eifellithus turriseifeli* Zone

This interval (1160m -1252m) is characterized by the occurrence of the following calcareous nannoplankton: *Watznaueria barnesae*, *W. britannica*, *Eifellithus turriseifeli*, *Rucinolithus irregularis*, *Nannoconus truitti*, *N. regularis*, *N. truitti frequens*, *N. minutus*, *N. frequens*, *N. truitti*, *Lithraphidites carniolensis*, *Zygodiscus diplogrammus*, *Rhagodiscus angustus*, *Cretarhabdus conicus* and *Straurhabdus quadricellus*. These species are recorded from Bahariya Formation with thickness 92 m. It is assigned to the Albian – Cenomanian age and according to the present study this zone is equivalent to the assemblage zone V (Cenomanian) of palynomorph biozones Fig (6).

Some stratigraphically important calcareous nannoplankton are photographed and illustrated on plates (III).

U. JURASSIC–L. CRETACEOUS BOUNDARY

Unconformity surface or a big hiatus is observed, between assemblage zone II and assemblage zone III of palynomorph zones and between *Conusphaera mexicana* zone and *Nannoconus colomi* zone of nannoplankton zones (fig.6), which causes the absence of the Upper Jurassic sediments (Kimmerdigian and Tithonian) and Lower Cretaceous sediments (Berriasian and Valanginian). This may be delineated the absence of Early Cretaceous and Upper Jurassic assemblages. The Hauterivian – Barremian assemblage are *Lithraphidites bollii*, *Nannoconus colimi*, *N. minutus*, *N. circularis*, *N. steinmanni*, *N. globules*, *Lithraphidites C. carnial*, *Pseudolithraphidites quattuorbacill*, *N. bucheri*, *N. abundans* and *Parhabdolithus asper*. Most study of the genus *Nannoconus* subsequently have indicated that this genus is almost synchronous with the Jurassic / Cretaceous boundary, [108, 113, 114, 115, 116, 117, 111].

In the present study calcareous nannofossils of the Jurassic / Cretaceous boundary are defined by the first occurrence of the genus *Nannoconus*.

Barremian rock units are overlying Oxfordian rock units. This time interval is dominated by sandstone with minor streaks of shale. The microspore assemblage herein is more frequent and diverse characterized by presence of *Murospora Florida* and *Impardecispora apiverrucata* species associated with other smooth trilete spores. Marine dinocysts are few in number mainly of *Cribroperidinium orthoceras* and *Systematophora* sp.

The Oxfordian is represented in the study well in its the upper part mainly of by (carbonate) dolomitic limestone and alternating with shale in its lower part. This time unit is represented by Masajid Formation and the topmost part of Khatatba Formation. The miospore assemblage is characterized by the occurrence of *Klukisporites pseudo-reticulatus* and *Concavissimisporites punctatus* beside gymnosperm pollen

grains related to the genera: *Classopollis*, *Callialasporites* and *Monosulcites*. Marine dinocysts are more diverse compared to the above assemblage. Most taxa belong to the gonyaulax type, including *Korystocysta gochtii*, *Wanaea digitata*, *Ctenidodinium panneum*, *Ctenidodinium chondrum*, *Gonyaulacysta jurassica* and *Lithodinia jurassica*.

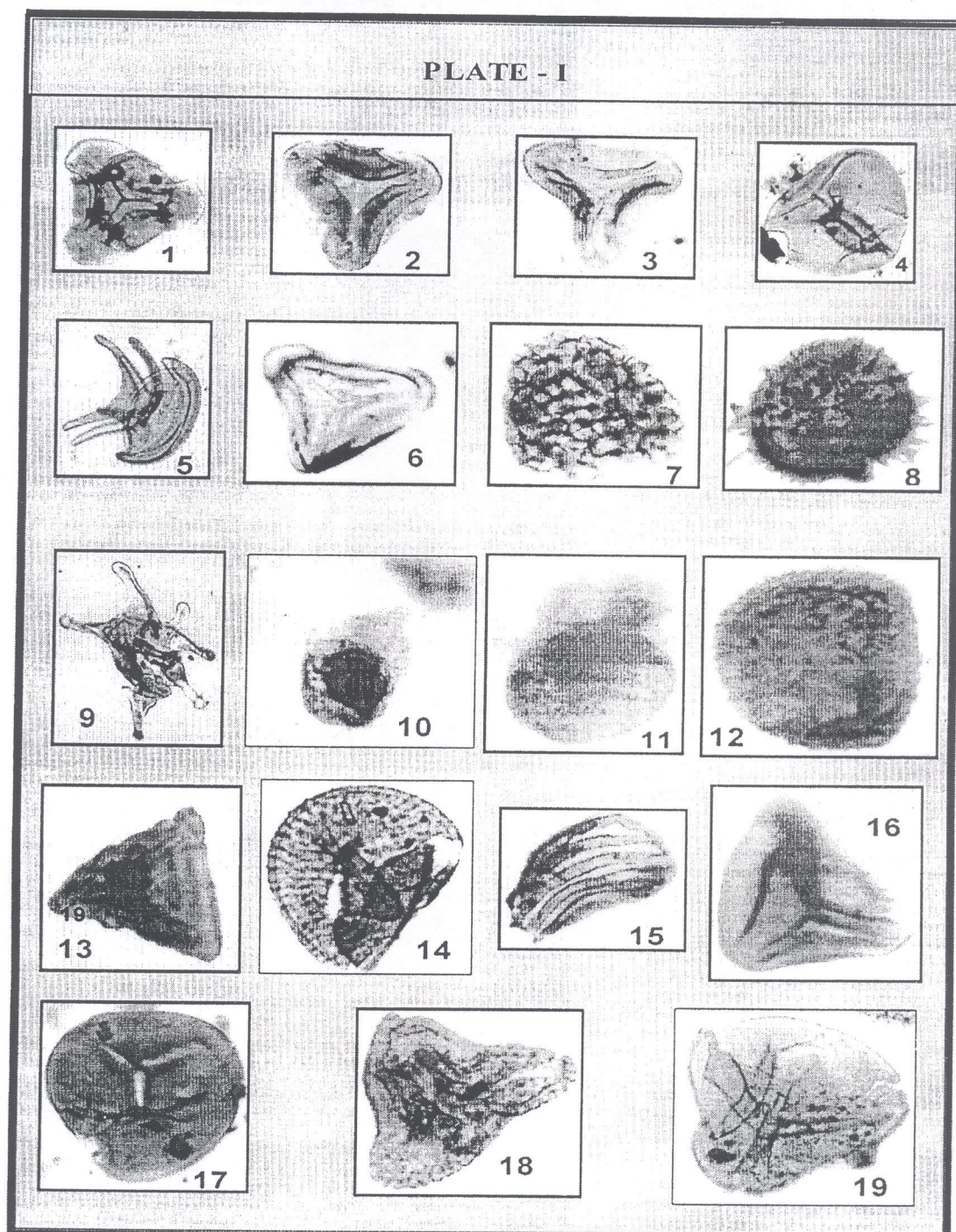
Plate (I)**(Magnification Approx. X 1000)**1- *Concavisporites jurienensis* Balme'.2, 3- *Gleicheniidites senonicus* Ross.4,19- *Dictyophyllidites harrisii* Couper.5- *Elaterosporites klaszii* Jardine.7- *Verrucosisporites* sp.8- *Pilososporites* sp. (thick spines).9- *Elaterocolpites castelaini* Jardine10,11- *Balmeisporites* sp.12- *Pilososporites* sp. (fine spines).13,15- *Cicatricosisporites* sp.14 - *Cicatricosisporites minutistriatus*
(Bolchoviian) Pocok.16- *Murospora florida* Balme.17- *Todisporites major* Couper.18-*Trilobosporites trioreticulosus*
Cookson and Dettman.

Plate (II)**(Magnification Approx. X 1000)**

- 1,2- *Afropollis jardinus* (Brenner) Doyle *et al.*
- 3- *Callialasporites dampieri* (Balme) Dev, Sukh.
- 4,5 - *Tetracolpites* sp.
- 6- *Microfoveolatosporis skottsbergii* Couper.
- 7- Diad pollen.
- 8 - *Araucariacites australis* Cookson.
- 9- *Gonyaulacysta jurassica* (Deflandre) Norris & Sarjeant.
- 10- *Rorystocysta gochtii* (Sarjent) Woolliam.
- 11- *Ctenidodinium panneum* (Norris) Lentin & William.
- 12- *Oodnadattina tuberculata* (Cookson & Eisenack) Below.
- 13- *Subtilisphaera* spp.
- 14- *Isabelidinium* sp.
- 15- *Cribroperidinium edwardsii* (Cookson and Eisenack) Davey.
- 16- *Apteodinium australlense* (Deflandre and Cookson) Williams.
- 17- *Pseudoceratium securigium* (Davey & Cookson) Davey & William.
- 18- *Korystocysta gochtii* (Sarjeant) Woolam.
- 19- *Meiourogonaulax* sp.
- 20- *Ctenidodinium* sp.
- 21- *Subtilisphaera senegalensis* Jain & Mill.
- 22- *Florentinia* spp. ,
- 23- *Florentinia radiculata* Davey & Williams.
- 24- *Oligosphaeridium complex* (White) Davey and Williams.
- 25- *Coronifera tubulosa* Cookson and Eisenack.

PLATE - II

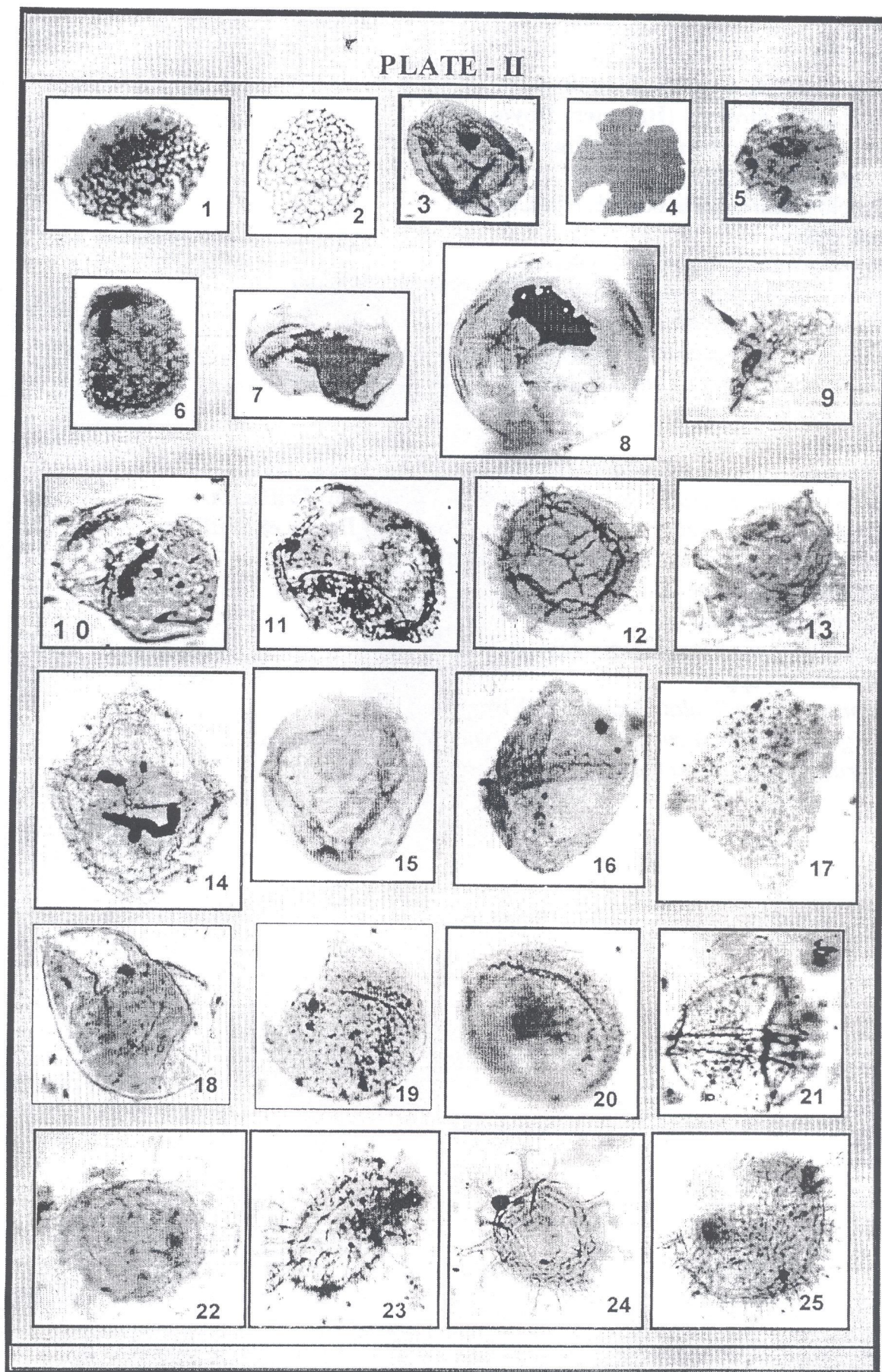
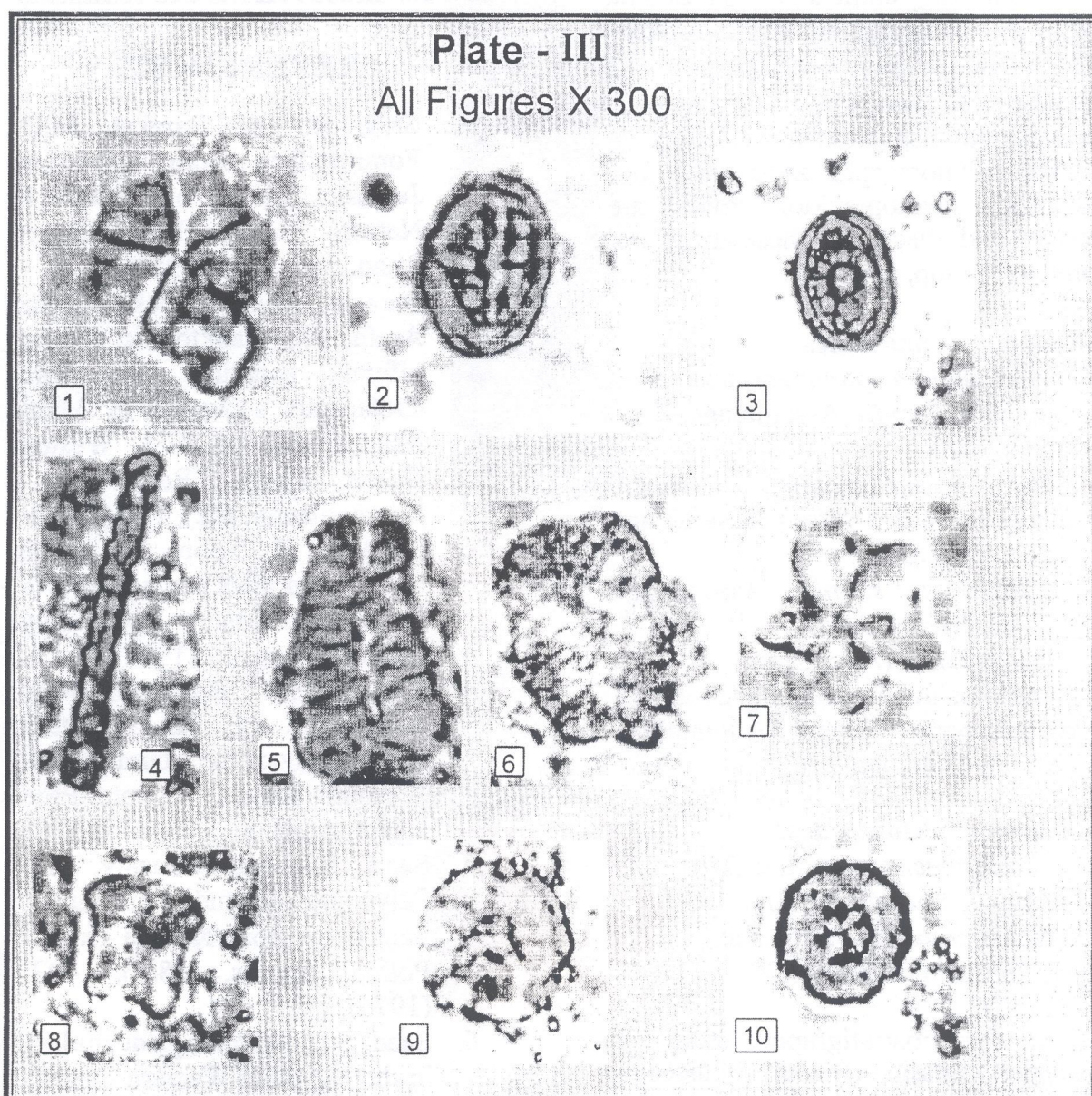


Plate (III)**(Magnification x 2000)**

- 1- *Braarudosphaera regularis* Black.
- 2- *Vagalapilla metalosa* Stover.
- 3- *Parhabdolithus asper* Stradner.
- 4- *Lithraphidites bollii* Thierstien.
- 5- *Nannoconus steinmannii* Kamptner.
- 6- *Nannoconus colomii* Kamptner.

7- *Braarudosphaera africana* Stradner.8- *Nannoconus abundans* Stradner & Grun .9- *Nannoconus circularis* Deres & Acheriteguy.10- *Cyclagelosphaera deflandrei* & Noel.

SUMMARY AND CONCLUSION

The present study deals with the lithostratigraphy and biostratigraphy of the Upper Jurassic – Lower Cretaceous sequence in Bed 8-1 well drilled, in the northern part of the Western Desert, Egypt.

Seven rock units are recognized. They are, from base to top; Khatatba, Masajid, Shaltut, Alamein, Kharita, Bahariya and Abu Roash "G" formations.

The biostratigraphic study is based on the study of calcareous nannoplankton and palynomorphs assemblages. 83 palynological species and 36 calcareous nannoplankton species are identified.

Five palynomorphs zones and four calcareous nannoplankton zones are detected and discussed. These zones are, from base to top, as follows:

A- Palynomorphs zones:

- I- *Ctenidodinium panneum* and *Korystocysta gochti* Assemblage Zone (Callovian).
- II- *Gonyaulacysta jurassica* and *Hystriichosphaerina orbifera* Assemblage Zone (Oxfordian).
- III- *Muderongia simplex* Assemblage Zone: (Barremian).
- IV - Barren Zone: (Aptian).
- V- *Concavissimisporites punctatus* and *Elaterosporites klaszii* Assemblage (Albian-Cenomanian).

B - Nannoplankton zones:

- 1- *Conusphaera mexicana* Zone.
- 2- *Nannoconus colimi* Zone.
- 3- *Nannoconus bucheri* Zone.
- 4- *Eifellithus turriseifeli* Zone (1160-1252).

From the biostratigraphic study of the Upper Jurassic - Lower Cretaceous rock units, it could be recognized the absence of the Upper Jurassic (Kimmeridgian and Tithonian) and

Lower Cretaceous (Berriasian and Valanginian) sediments of BED 8-1 well. This is due to an unconformity or due to big hiatus.

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